ACRED: ARM Cloud Retrieval Ensemble Data Set

The ARM Cloud Retrieval Ensemble Data Set (ACRED, Zhao et al. 2011) is a multi-year ensemble cloud microphysical property data set, created by assembling nine existing ground-based cloud retrievals of ARM measurements from cloud radars, lidars, and the atmospheric emitted radiance interferometer (AERI) (i.e., MICROBASE, MACE, CLOUDNET, DENG, SHUPE_TURNER, WANG, COMBRET, RADON, and VARCLOUD). The major cloud properties in ACRED are the cloud liquid effective radius, liquid water content, liquid water path, cloud ice effective radius, ice water content, and ice water path. Some products also contain quantities such as cloud fraction, total column cloud fraction, cloud liquid optical depth, and ice optical depth at solar wavelength, which are also included in ACRED. For each variable, three types of quantities are provided: the time means, standard deviations, and quality control (QC) flags. Currently, the ACRED is available at five ARM permanent research sites: SGP.C1 (Lamont, OK), NSA.C1 (Barrow, AK), TWP.C1 (Manus Island, PNG), TWP.C2 (Nauru), and TWP.C3 (Darwin, AU). For each site, ACRED contains three to six retrieval products for multiple years. The current version of ACRED includes hourly averaged cloud properties and has 512 vertical layers with a resolution of 45 m.

The ACRED data set is developed to address the uncertainty issue within current cloud retrievals (Zhao et al. 2012), as large differences exist in current cloud products retrieved from ground-based remote sensing measurements using various retrieval algorithms. It provides a rough estimate of the uncertainties in current ARM retrieved cloud microphysical properties for climate model evaluation and development. Additionally, the ACRED serves as a useful tool to understand uncertainties or bias that are closely associated with the retrieval techniques, which is an important step to further improve the representation of cloud processes in climate models.

One concern with the current ACRED is that the uncertainty in each of the ensemble members has not been determined for all meteorological conditions. This could be addressed by 1) to generate an ensemble data set for each of the algorithms by perturbing key parameters and/or changing key assumptions used in these selected retrieval methods as demonstrated in Zhao et al (2014), 2) to create observation system simulation experiment data sets and run the algorithms on these. In general, the retrieval techniques used by the nine ARM ground-based retrieval products contained in the ACRED differ from each other in their retrieval fundamental basis, assumptions used, retrieval inputs, and retrieval constraints. We recommend that users refer to the technical report and science papers listed below or contact the relevant ARM Translators for more information on the data limitation and uncertainties for this data product.

References:

Zhao, C., S. Xie, S. A. Klein, R. McCoy, J. M. Comstock, et al. 2011: ARM Cloud Retrieval Ensemble Data Set (ACRED). Available at https://www.arm.gov/publications/tech_reports/doe-sc-arm-tr-099.pdf.

Zhao, C., S. Xie., S. A. Klein, A. Protat, M. D. Shupe, et al. 2012: Toward understanding of differences in current cloud retrievals of ARM ground-based measurements. *JGR-Atmospheres,* **117,** D10206, doi:10.1029/2011JD016792.

Zhao, C., S. Xie, X. Chen, M. Jensen, and M. Dunn, 2014: Quantifying uncertainties of cloud microphysical property retrievals with a perturbation method. J. Geophys. Res. Atmos., 119, 5375–5385, doi:10.1002/2013JD021112.